IN THE SPECIFICATION

Please replace the below-indicated paragraphs with the following rewritten paragraphs.

[0004] Smart antennas are arrays of antenna elements, each of which receive a signal to be transmitted with a predetermined phase offset. The net effect of the array is to direct a (transmit or receive) beam in a predetermined direction. The beam is steered by controlling the phase relationships of the signals which excite the elements of the array. Thus, smart antennas direct a beam to each individual user (or multiple users) as opposed to radiating energy to all users within a predetermined coverage area (e.g., 120°) as per conventional antennas. Smart antennas increase system capacity by decreasing beam width and thereby decreasing interference. With a reduction in interference, increases in signal-to-interference and signal-to-noise ratios result allowing for improved performance and/or capacity. ~~Power controlled systems, this results~~ This can result in a reduction of the transmit power for a given level of performance.

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[0006] In addition, this system works well in environments where energy is received from the user via a straight line. Unfortunately, in some ~~(e.g. urban)~~ environments (e.g. urban) this condition does not hold as the signal is often reflected off buildings and other structures and received as a multipath beam.

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As changed in the preliminary amendment, please make the change in the description of Fig. 5.

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[0016] Fig. 5 is a simplified block diagram of the smart antenna ~~processor~~ antenna.

[0021] Fig. [[1]] 2A is a block diagram showing one sector of a basic conventional cellular system. The system 10' includes a base station 20' which transmits and receives signals to and from a plurality of subscriber units 30' utilizing the three sector antennas 22', 24' and 26', respectively. Each antenna is designed to provide a 120° sector of coverage 28'. The area of coverage provided by the three antennas ~~(e.g, 26',22',24')~~ in Fig. [[1]] 2A is shaded. ~~Hence, three~~ Three antennas sets are typically used to provide 360° coverage required for each cell. In Fig. [[1]] 2A, the base station 20' uses one transmit (forward link) antenna [[26']] 24' and two diversity (return link) antennas, 22' and [[24']] 26' as is common in the art. While this approach

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has been used effectively to date, the capacity thereof has been somewhat limited. As mentioned above, smart antennas are being utilized to increase the capacity of a cellular telephone.

[0022] Fig. [[2]] 2B is a diagram of a cellular telephone system utilizing a smart antenna system. The system 10'' of Fig. 2 is similar to that shown in Fig. 1 with the exception of a smart antenna array 40' in lieu of the three sector antennas 22', 24', and 26' of Fig. [[1]] 2A. The coverage sector 28' of the conventional system depicted in Fig. [[1]] 2A is shown for comparison. As shown in Fig. [[2]] 2B, smart antennas are arrays of antenna elements 42', each of which receive a signal to be transmitted with a predetermined phase offset. The net effect of the array 40' is to direct a transmit or receive beam 44' in a predetermined direction. Each beam is controllable by controlling the phase relationships of the signals used to excite (or received from) the elements 42' of the array 40'. Thus, smart antennas direct a beam to each individual user as opposed to radiating energy to (or receiving energy from) all users within a predetermined coverage area (e.g., 120°) as per conventional antennas. Hence, smart antennas increase system capacity by decreasing beam width and thereby decreasing interference. With a reduction in interference, an increase in signal-to-interference and signal-to-noise ratio result allowing for improved performance and/or capacity.

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[0024] Unfortunately, in some environments (e.g. urban environments) this condition does not hold as the signal is often reflected off of buildings and other structures and received as a multipath beam. ~~This is depicted in Fig. 3.~~

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~~[0025] Fig. 3 is a diagram showing the propagation components of the electro magnetic field between one subscriber unit and the base station. Fig. 3 shows four multipath components, which are caused by reflection or scattering by the environment.~~

[0027] Fig. [[4]] 3 is a block diagram of an illustrative implementation of a mobile unit in accordance with the present teachings. The mobile unit 30 includes a first antenna 32 adapted to receive position location signals from a remote system such as the Global Positioning System. Signals from the GPS antenna 32 are processed by a GPS signal processor 34. The GPS processor 34 outputs position data to a system controller 36 which selectively multiplexes the position data with provided via a user interface 37 for transmission by a transceiver 38. In the preferred embodiment, the transceiver 38 is a code division multiple access transceiver. However, those of ordinary skill in the art will appreciate that the invention is not limited thereto.

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The present teachings may be utilized with other communications technologies such as TDMA or GSM without departing from the scope of the present teachings

[0028] As discussed more fully below, in the preferred embodiment, a GPS assisted arrangement is employed by which GPS overhead data is received by the base station [[20]] 20' and transmitted to the mobile unit 30 to shorten acquisition time. In addition, the unit 30 is adapted to receive a signal from an airborne platform as well as from a satellite based platform. In any case, position location data is transmitted by the transceiver 40 to the base station [[20]] 20' shown in Fig. [[5]] 4.

[0029] Fig. [[6]] 4 is a block diagram of an illustrative implementation of a base station in accordance, with the teachings of the present invention. As shown in Fig. [[6]] 4, the base station [[50]] 20' includes a smart antenna array 40 of spatially localized radiating elements 42. The array 40 may be of a conventional phased array antenna design. In the preferred embodiment, the array 40 is part of a Smart Antenna system and feeds a smart antenna processing circuit 50. As shown in Fig. 5, [[The]] the processing circuit 50 includes a plurality of receivers 52, a number of beamforming elements 54, a spatial processor 60 and a Rake receiver 70.

[0030] Returning briefly to Fig. [[5]] 4, ~~in accordance with the present teachings,~~ a system processor 100 provides base station position data from a GPS signal processor 110 to the ~~Spatial~~ spatial processor 60. As discussed more fully below, the processor is programmed, in accordance with the present teachings, to utilize the position data provided by the user and the base station position data to steer the beams output by the array 40.

[0031] Fig. [[6]] 5 is a block diagram of an illustrative embodiment of a smart antenna system incorporating the teachings of the present invention. As shown in Fig. [[6]] 5, each of the n elements 42 of the antenna array 40 feeds an associated one of n receivers 52. In the illustrative embodiment, each receiver 52 downconverts and demodulates the signal received by the element 42 and performs matched filtering appropriate for a given user. Consequently, each receiver accepts a radio frequency (RF) input signal from an antenna element and processes it to output a baseband signal per each user.

[0034] For a CDMA based system, an optimal beamforming solution, from a user capacity perspective, is achieved by maximizing the Signal-to-Noise-plus-Interference Ratio. Utilizing typical methods such as the "Optimal Wiener Solution" results in added complexity, cost and

potential time delays within the system. In many cases a "near optimal" solution can be achieved with the present teachings, requiring far less complexity, cost and time delay. This is illustrated with respect of Figs.~~7—9 below.~~ 1, 6, and 7.

[0035] Fig. [[7]] 1 is a flow diagram of a beamforming algorithm implemented in accordance with conventional teachings based on a Minimum Mean Squared Error Algorithm. As illustrated in Fig. [[7]] 1, the process [[200']] 100 includes the steps of acknowledging user access of the system at step [[210']] 110 and generation of a pilot signal in response thereto at step [[220']] 120. At step [[230']] 130 a received signal vector is sampled and, at step [[240']] 140, used to create an equation of the beamformer output. At step [[250']] 150, an error function is created between the pilot signal and the beamformer output. Next, at step [[260']] 160, the error function is minimized using the Wiener-Hopf equation or the Optimum Wiener solution. Finally, at step [[270']] 170, optimized weights are applied to the beamformer. Unfortunately, the calculation of the weights involves the calculation of eigenvalues and other linear algebra operations which require numerous processor operations.

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[0036] In accordance with the present teachings, these problems are obviated by using user position data and (local terrain data) to determine beamformer weights. The method is the present invention is best illustrated with reference to Fig. [[8]] 7.

[0037] Fig. [[8]] 7 is a flow diagram illustrative of the spatial processing method utilized by the method for directing narrow beams of the present invention. The novel method [[200]] 700 ~~invention~~ uses the user position data and, optionally, local terrain data to determine the beamformer weights and includes the step ~~(210)~~ 701 of acknowledging user access of the system. If, at step [[220]] 703, the user reports his position, then at step [[230]] 704, the algorithm shown in Fig. [[9]] 6 is used.

[0038] Fig. [[9]] 6 is a flow diagram of an illustrative algorithm used to provide beamforming to a user reporting his position in accordance with the teachings of the present invention. At ~~steps 232 and 234~~ step 601 the user's position and the position of the base station 20 are provided to the spatial processing unit 60 (Fig. [[6]] 5) which, at step [[236]] 603 calculates the direction of the user with respect to the base station. Those skilled in the art will appreciate that the present teachings are not limited to the manner by which the user's position is determined. Other techniques may be used to determine user and base station position without departing from the scope of the present teachings. The direction of the user is calculated by converting the GPS

coordinate data to beamforming coordinate data and by using trigonometric techniques well-known to those skilled in the art.

[0039] Next, at ~~steps 238 and 240~~ step 605, the number and direction of the beams is calculated using information supplied by an optional multipath database [[240]] 62 shown in Fig. 5.

[0040] The data base could be either based on analysis of the surroundings, or a measurement is performed. Measured data is assumed to be more accurate. A mobile would be driven throughout the coverage area. Mobile position and angle of arrival of the energy would be logged. This data would be used to create the multipath database. Finally, at step [[242]] 607, the gain and phase of the antenna pattern is determined using antenna array characteristics supplied at step [[244]] 605.

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[0041] Returning to Fig. [[8]] 7, at step [[220]] 703, if the user does not report his location, the system uses an algorithm that generates a pattern that covers the entire sector (step 705').

[0042] Returning to Fig. [[5]] 4, the output of the smart antenna processor 50 is input to a transceiver 80 of design and construction compatible with the transceiver 38 of the mobile unit 30. The transceiver 80 communicates with an external network such as a Public Switched Telephone (PSTN) 140 via a bi-directional switch 130.